Fall 2018

BIOL 368-H01: Ecology & Evolution of Disease

Gareth Russell

NJIT BIOLOGY

Course Syllabus

FALL 2018

BIOLOGY 368-H01: ECOLOGY & EVOLUTION OF DISEASE HONORS

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OFFICE:	428H Central King Building	**EMAIL:**	russell@njit.edu
OFFICE HOURS:	M, W: 11:30 am - 1:00pm or By Appointment	**COURSE SCHEDULE:**	M, W: 10:00 - 11:25am, CKB 313

COURSE DETAILS

INTRODUCTION: **Ecology and Evolution of Disease** addresses those aspects of ecology and evolutionary biology most relevant to understanding the origin, dynamics and treatment of disease (both infectious and hereditary/genetic). It is particularly recommended for pre-health students, including those in the Accelerated Programs, and serves as an introduction to the science behind public health. As well as basic biology, material covered will include aspects of human behavior, as well as some mathematical models. The course follows a "flipped" model, with class time devoted to discussion as well as group and individual activities intended to reinforce the basic material. While designated Honors, this course is open to all with the necessary background (see the pre-requisites below). But it is taught at an advanced level, and assumes you have learned *and retained* knowledge about fundamental evolutionary and ecological processes. Without this background, you will struggle to do well.

PREREQUISITES: Foundations of Ecology and Evolution is **required**. (General Biology or Concepts in Biology is not sufficient). An upper level ecology or evolution course is **recommended**. It will also be assumed that you know the basics of cell biology and genetics, so Foundations of Cell and Molecular Biology (or equivalent) is also recommended, as is a basic ability in algebra so that model formulations can be followed.

CLASS NEEDS: We will often be accessing information in class, and so it will be helpful for as many students as possible to have internet access. So, if you have a laptop or tablet, please bring it. You can use a phone instead, but it won't be as good. If you don't have a suitable device, don't worry: most of this work will occur in groups where devices can be shared.

CREDITS: 3

SCHEDULE: Class meets Monday and Wednesday, 10:00am to 11:25am, in CKB 313 on the NJIT campus. I expect you to attend class *and arrive on time.*

TEXTBOOKS: There are two **required** textbooks. They are in the NJIT bookstore.

- *Evolutionary Medicine* by Stephen C. Stearns and Ruslan Medzhitov. ISBN 978-1-60535-260-2

- *Plague Time* by Paul Ewald. ISBN 0385721846. (Note that there are two editions of this book, with different subtitles. The only other difference is in the Foreward — the one subtitled "The New Germ Theory of Disease" has an updated forward that mentions a few case studies that occurred after the original version. If you have the other version, don't worry.)

The following book, which is one of the foundations of the field, you might also find helpful, so it is **recommended**. You can get it for about $10 on amazon.com

- *Why We Get Sick* by Randolph M. Nesse and George C. Williams. ISBN 0679746749.

WEBSITES AND LINKS: The class will use Moodle, Google Classroom, and the external website structuralecology.net

GRADING & EXAMS: There will be two exams (a mid-term and a final), six short writing assignments, and a longer, semester-long writing assignment. The grading will be as follows:

Component	Percentage
Pre-requisite quiz	5%
Short writing assignments (total)	20%
Participation in class activities	5%
Current event postings	5%
'Explainer' writing assignment	25%
Mid-term Exam	20%
Final Exam	20%
Total	**100%**

PREREQUISITE QUIZ: At the end of the second week, there will be a short quiz on various pre-requisite topics. You will be given a listing of topics on the first day of class. These are all things which you should recall from Foundations of Ecology and Evolution, and to some extent also Concepts in Biology (or a General Biology course if you are a transfer student) and high school biology. Getting back up to speed on this material right away will let us explore more interesting topics later.

SHORT WRITING ASSIGNMENTS: You will be graded on the best three out of six. The idea behind the short writing assignments is that you will get better at doing them, and your scores will increase. If you manage to do at least four excellent ones by the end of the semester, you will get the full 'quality' score!

Component	Total
2 points for simply doing each assignment 'adequately.'	12
A quality score for each assignment out of 6, *top three scores only count*	18
Total	**30***

*Counts for 20% of your final grade.

PARTICIPATION: Please note that this is a flipped course, so participation in class activities is **essential**. You start with all five participation percentage points. If you start being regularly late to class, or missing classes without an acceptable reason, you will start losing points. I will give you a warning if that is about to happen.

This is not an arbitrary rule: it is the nature of a flipped class that only the students who come to class will succeed. I want you to succeed, and I hope you want to as well!

CURRENT EVENT POSTINGS: You will be asked to keep an eye on the news and post any interesting articles related to the course. There will be plenty to find.

'EXPLAINER' WRITING ASSIGNMENT: The class is going to write a 'Conservation Reader' — a single document with chapters on certain 'of the moment' topics in public health. They will be written in the style of a quality magazine article (think *Time*).

SYLLABUS

- **Important Note: Conservation is a dynamic field, so the syllabus is a little bit different every time the course is taught!** Some the details may even change even as the semester progresses. The reason is that there is usually some emergent infectious disease in the news that we can use as an overall case study. Last year it was Zika virus. Before that it was Ebola. What is it this year? The syllabus below provides a general outline of topics, but the specifics and timings may still change. Check back here regularly for updates.
- Textbook readings are identified as "EM" (Evolutionary Medicine) and "PT" (Plague Time). Other readings are provided as PDF files — click on the name to download each one.

Learning goals

Content learning goals

After taking this course, students will

1. Understand the evolutionary factors driving or influencing a variety of non-infectious ailments (such as obesity, heart disease).
2. Understand the ecological *and* evolutionary factors driving or influencing infectious diseases (such as cholera, malaria, or HIV).
3. Understand how failing to take into account evolutionary and ecological principles when addressing disease can have unfortunate consequences (e.g., antibiotic resistance, virulent 'super-bugs' etc.).
4. Understand the basis and evidence for 'germ theory', which posits that a number of diseases traditionally thought of as non-infectious may, in fact, be caused by cryptic infectious agents.
5. Understand the multi-disciplinary teamwork required in the field public health.

Skill learning goals

After taking this course, students will

1. Be proficient at reading and extracting the important data and conclusions from scientific publications.
2. Be able to summarize the message of a scientific publication in a few sentences.
3. Be able to recognize and 'read' simple mathematical models of infectious disease.

COURSE OUTLINE:

Week 1 (Wed only): Introduction to the course.
Content: Class introduction and logistics. Assessment of student knowledge. Discussion of need for the course. Discussion of writing, and writing assignments. Discussion of notes, and note-taking. **Class activity:** Watch beginning of Dawkins lecture while making notes. In small groups, compare note-taking strategies and discuss. As a group write 250 word 'abstract' summarizing lecture. Discussion of levels of explanation. **Reading assignment (for next week):** EM Chapter 1.
Week 2: (Re-)introduction to Evolutionary Thinking
Content: Natural selection, neutral evolution, random change, mismatch, adaptation, styles of thought. **Class activity:** Examples of bad evolutionary thinking **Writing assignment (for Wednesday): Jernberg et al. 2010** **Reading assignment (for next week):** EM Chapter 2
Week 3: What is a patient?
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 3.
Week 4: What is a disease?
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 4
Week 4: What is a disease?
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 4
Week 5: Defenses
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter5
Week 6: Pathogen Evolution
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 6
Week 7: Cancer
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 7
Week 8: Reproductive Medicine
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 8
Week 9: Mismatch
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 9
Week 10: Mental Disorders
Writing assignment (for Wednesday): **Reading assignment (for next week):** EM Chapter 10
Week 11: Individual Health vs. Population Health
Class activity: Disease models **Writing assignment (for Wednesday):** **Reading assignment (for next week):** PT Chapters TBA
Week 12: Germ Theory 1
Writing assignment (for Wednesday): **Reading assignment (for next week):** PT Chapters TBA
Week 13: Germ Theory 2
Writing assignment (for Wednesday): **Reading assignment (for next week):** None
Week 14: Germ Theory 2
Review **Final exam** **Date: TBA**
FINALS WEEK – DECEMBER 15 – 21,2018